GEOTECHNICAL STUDY
FEDERAL LAW ENFORCEMENT TRAINING CENTER
OFFICE BUILDING
EL PASO, TEXAS

AEE JOB NO. 0-717-000246

Submitted To:

Leedshill-Herkenhoff, Inc.
500 Cooper Avenue NW, Suite 500
Albuquerque, New Mexico 87103

Submitted By:

AGRA Earth & Environmental, Inc.
125 Montoya Road
El Paso, Texas 79932

August 2, 2000

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October 9, 2000
AMEC Job No. 0-717-000246
Addendum No. 1

Leedshill-Herkenhoff, Inc.
500 Cooper Avenue NW, Suite 500
Albuquerque, New Mexico 87103

Attn.: Mike Zwolinski, P.E.

RE: Lateral Pile Analysis
Federal Law Enforcement Training Center
Office Building
Artesia, New Mexico

Dear Mr. Zwolinski:

Pursuant to discussions with Ms. Vicky Watt of Leedshill-Herkenhoff, Inc., we have reviewed our original Geotechnical Investigation Report for the above referenced project with respect to lateral loads for deep foundations.

The report suggests using the method presented by Reese and Matlock (1956)* to analyze the lateral resistance of concrete piers. Pursuant to conversations with Ms. Watt, it was decided that our firm would conduct the lateral load analysis using the computer program LPILE Plus 3.0 (1997).**

Analysis parameters included a pile diameter of 18 inches, embedment depth of 40 feet, a fixed (i.e., no rotation) condition at the pile head, and the soil profile as provided in the geotechnical report. It is further understood that the piles are to be arranged in groups with spacings of 4'-6" from center-to-center (three diameters). Based on the center-to-center pile spacing of three diameters, a lateral capacity reduction factor of 0.7 was applied to account for pile group effects.

Utilizing the above described parameters, the ultimate, allowable lateral load (i.e., for a factor of safety of 1.0) at a maximum deflection at the ground surface of 0.5 inches is 17.5 kips per pile in the group. This value is only valid for groups in which the piles are spaced at three diameters center-to-center. An additional passive resistance is developed in the pile caps founded at a depth of 3 feet below finished grade. A passive pressure for properly compacted structural fill against the pile cap should be computed using an equivalent fluid pressure of 340 pounds per cubic foot. It

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*Reese, L.C., and Matlock, H., "Non-Dimensional Solutions for Laterally Loaded Piles with Soil Modulus Assumed Proportional to Depth", Proceedings of the 8th Texas Conference on Soil Mechanics and Foundation Engineering, Austin, Texas, 1956, pp. 1-41.

**Reese, L.C., Wang, S.T., Arrellaga, J.A. and Hendrix, J., 1997 "LPILE Plus 3.0; A Program for the Analysis of Piles and Drilled Shafts Under Lateral Loads".

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should be noted, however, that the total passive resistance will not be developed until the maximum deflection occurs.

This addendum should be attached to the original report and be made a part thereof. Should any questions arise concerning this addendum, we would be pleased to discuss them with you.

Respectfully submitted,

AMEC Earth & Environmental, Inc.

Rosanne Gallo for

Daniel N. Fréchette, Ph.D., E.I.T.

Reviewed by:

Tony J. Freiman, P.E.
Senior Engineer

And:

Otto C. Holmquist, P.E.
Senior Engineer

c: Addressee (3)

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August 2, 2000
AEE Job No. 0-717-000246

Leedshill-Herkenhoff, Inc.
500 Cooper Avenue NW, Suite 500
Albuquerque, New Mexico 87103

Attn.: Mike Zwolinski, P.E.

Re: **Geotechnical Study**
Federal Law Enforcement Training Center
Office Building
Artesia, New Mexico

Dear Mr. Zwolinski:

AGRA Earth & Environmental, Inc. (AEE) submits this Geotechnical Report for the above referenced project. The report includes the results of test drilling and laboratory analyses and presents recommendations for foundation design.

Should any questions arise concerning this report, we would be pleased to discuss them with you.

Respectfully submitted,

AGRA Earth & Environmental, Inc.

David A. Varela, E.I.T.
Graduate Engineer

Reviewed by:

Otto C. Holmquist, P.E.
Project Engineer

OTTO C. HOLMQUIST
NEW MEXICO
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REGISTERED PROFESSIONAL ENGINEER

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TABLE OF CONTENTS

AEE Job No. 0-717-000246

1.0 INTRODUCTION

This report is submitted pursuant to a geotechnical study made by this firm of the site of a proposed office building to be constructed at the Federal Law Enforcement Training Center (FLETC) in Artesia, New Mexico. The object of this study was to evaluate the physical properties of the soil underlying the site to provide recommendations for foundation design. As a result of structural loading and other construction changes, AEE conducted this study to supplement a previous geotechnical study (AEE Job No. 9-717-00136) performed at the site in May 1998.

2.0 PROPOSED CONSTRUCTION

Details of the project were provided to AEE by Mike Zwolinski, P.E. of Leedshill-Herkenhoff, Inc.

It is understood that a four-story office building is planned for construction at the project site. The proposed building will have a footprint of approximately 15,000 square feet. Construction of the building will consist of steel framing with a brick veneer exterior. Structural loads for the building are expected to be heavy with a maximum column load of 300 kips.

Should final design details vary significantly from those outlined above, this firm should be notified for review and possible modification of recommendations.

3.0 SOIL STUDY

3.1 SUBSURFACE EXPLORATION

Three exploratory borings were advanced at the project site to a depth of 60 feet below existing grades. The test borings were completed using a CME 75 truck-mounted drill rig equipped with 8¼ inch O.D. hollow stem augers. Standard penetration testing was performed at selected intervals in the borings. During the field study, the soil encountered was continuously examined, visually classified and logged. Results of the field study are presented in Appendix A, which includes a brief description of drilling and sampling equipment and procedures, a site plan showing the boring locations and logs of the test borings.

The boring logs and related information included in this report are indicators of subsurface conditions only at the specific locations and times noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of AEE, exist at the sampling location. Note, too, that the passage of time may affect the conditions at the sampling locations.

3.2 LABORATORY ANALYSIS

To aid in soil classification and evaluate the engineering properties of the soil, selected soil samples were tested for moisture content, Atterberg limits and grain-size analysis. Laboratory tests were performed in accordance with test standards ASTM D 2216, ASTM D 4318 and ASTM D 422. The results of the moisture testing are presented in the boring logs found in Appendix A. Atterberg limits and grain-size analysis results are presented in Appendix B.

The soil encountered during the field study was classified in general accordance with the Unified Soil Classification System. The soil classification symbols appear on the boring logs and are briefly described in Appendix A.

4.0 SITE CONDITIONS & GEOTECHNICAL PROFILE

4.1 SITE CONDITIONS

The project site is located within the grass infield of an athletic track located at the FLETC facility. The topography of the site slopes to the northeast with approximately four feet of relief across the infield. In addition, an irrigation system is present within the field.

4.2 GEOTECHNICAL PROFILE

As the exploratory borings indicate, the soil underlying the site generally consists of a low to medium plasticity silty clay. Interbedded gravel and cobble zones were observed at about 30 to 35 feet below the ground surface at the boring locations. At boring B-1, the gravel and cobble zone was also encountered at approximately 20 feet below existing grades. Laboratory tests for the clay soil indicate liquid limits varying from 20 to 49 with corresponding plasticity indices of 8 to 31. Plasticity indices varying from 16 to 31 were previously tested at the site during our earlier study. Based on the laboratory test results, the clay soil has a low to moderate swell potential with changing moisture conditions. A potential vertical rise (PVR) value was calculated for the clay soil to evaluate the anticipated volumetric swell based on the plasticity index and moisture content of the soil. A PVR of up to 0.9 inches was calculated for the clay soil assuming a dry moisture condition.

A slight to moderate lime cementation was also encountered at the boring locations. The carbonate cemented soil was generally observed at depths varying from 5 to 9 feet extending to depths of 40 to 50 feet below the ground surface.

The relative firmness of the soil generally ranges from moderately firm to hard. During our past geotechnical study, soft compressible soil zones were detected at approximately 2 feet and again at about 7 to 10 feet below existing grade. The soft soil zones are considered to be moisture sensitive and have the potential for excessive differential settlements with changing moisture and loading conditions.

The descriptives for firmness are based on grain size and standard penetration tests as detailed in "Terminology Used to Describe the Relative Density, Consistency or Firmness of Soil" in Appendix A of this report.

4.3 SOIL MOISTURE AND GROUNDWATER CONDITION

At the time of the field study, no groundwater was encountered in any of the exploratory borings performed at the site. Soil moisture contents were found to be dry to moist varying from 4 to 23 percent in the samples tested.

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 ANALYSIS OF RESULTS

Based on the results of the field and laboratory testing, the softer soil zones observed at the site are not considered suitable to adequately support the proposed structure. As a result, a deep foundation system consisting of either auger cast piles or cast-in-place drilled piers is recommended to support the structure. It is anticipated that with auger cast piles, a pier group will be required to support the proposed structure.

5.2 DEEP FOUNDATION SYSTEM

5.2.1 DOWNWARD LOADS

Estimated safe capacities for downward loads for various diameters for auger cast piles or drilled piers are presented in Appendix D. The chart shows the relationship between safe downward capacities versus depth of penetration below lowest adjacent finished grade. A minimum penetration of 20 feet below finished grade is recommended. The safe upward capacity of these piers can be considered as being 80 percent of the safe downward capacities for the various pier diameters. Center to center distance between piles or piers should not be less than three times the diameter of the piles or piers. For center to center distances between three and six times the piles or pier diameters, the vertical capacity of each should be reduced by one third. For piles or piers, diameters greater than six times the diameter of the piers or piles, no reduction of the vertical capacity applies.

The estimated capacities apply to full dead plus realistic live loads and can be safely increased by one-third for temporary loads including wind or seismic forces. Capacities apply to the allowable soil supporting capacity and do not consider the structural strength of the piers.

5.2.2 LATERAL LOADS

Drilled piers can be drilled vertically and designed to resist lateral loads. The method presented by Reese and Matlock (1956)[1] can be utilized for analyzing lateral resistance of concrete piers. A coefficient of horizontal subgrade reaction (n_h) of 30 pounds per cubic inch (pci) is recommended

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1 Reese, L.C., and Matlock, H., "Non-Dimensional Solutions for Laterally Loaded Piles with Soil Modulus Assumed Proportional to Depth", Proceedings of the 8th Texas Conference on Soil Mechanics and Foundation Engineering, Austin, Texas, 1956, pp. 1-41.

for use with this method. Where this method is utilized, it is recommended that a factor of safety of 3.0 be employed to determine safe capacities. It is recommended that the resisting surface be considered as being 1.0 foot below finished grade.

5.2.3 ESTIMATED FOUNDATION MOVEMENTS

Upward and downward movements of drilled piers are expected to be less than about ¾ of an inch. Movements at the ground surface of drilled piers subject to lateral loads are estimated not to exceed 0.5 inches.

5.3 CONSTRUCTION CONSIDERATIONS

5.3.1 GEOTECHNICAL CONDITIONS

Although drilling conditions for pier installation are not anticipated to be difficult, the gravel and cobble layers encountered at the boring locations may be difficult to penetrate. As a result, equipment should be adequately sized to advance the pier to the depth required.

5.3.2 POSITIONAL TOLERANCES

All drilled piers should be installed so that the centerline of the top of the pier is within 3 inches of the plan location. Vertical piers with diameters of 3 feet or more should deviate from plumb no more than 2 percent of the pier length or as determined by the structural engineer based on the structural properties of the shaft and lateral restraint properties of the soil penetrated.

5.3.3 CLEANING OF PIER EXCAVATIONS

After each shaft has been advanced to its planned depth, the bottom of the excavation should be cleaned of slough and loose material in a manner acceptable to the geotechnical engineer. The cleaning should ultimately result in the bottom of the excavation having an average of no more than 4 inches of disturbed material prior to placement of concrete.

Various techniques may be used at the contractor's option to accomplish the cleaning. Options include vacuum cleaning or careful machine-cleaning with rig-mounted tools. If rig-mounted tools are used, they should be approved by the geotechnical engineer.

5.3.4 PLACEMENT OF CONCRETE

Before any concrete is placed, the pier hole should be inspected by a representative of the geotechnical engineer (RGE). The drilled hole should be dry, free of loose or softened soil and should be cleaned from the base. If the base of the hole is wet, a layer of dry concrete should first be placed and well compacted.

Concrete should be placed in one continuous operation through a hopper, tremmie, drop chute or other device approved by the geotechnical engineer so that it is channeled in such a manner to free fall and clear the walls of the excavation and reinforcing steel until it strikes the bottom. Adequate compaction will be achieved by free fall of the concrete up to the top 5 feet. The top 5 feet should be designed to achieve the required compressive strength while maintaining a slump during placement in the range of 5 to 7 inches.

If casing is utilized to support the walls of the hole, casing withdrawal should be carefully coordinated with concrete placement. Consideration should be given to a specifically designed concrete with adequate slump and a retarder to prevent arching of concrete during casing removal or setting of concrete until the casing is fully withdrawn.

5.3.5 CONSTRUCTION QUALITY ASSURANCE

Continuous observation of the construction of drilled pier foundations should be carried out by the RGE. The RGE should verify the proper diameter of the shaft, depth, cleaning and also confirm the nature of materials encountered in the pier excavations. Concrete placement should be continuously observed to ensure that it meets requirements. A quality assurance report should be submitted on each pier stating all details have been observed and affirming that the pier meets construction requirements.

5.4 SITE GRADING AND SLAB SUPPORT

A slab-on-grade or "floating slab" may be constructed for the proposed building. It should be noted that differential movements, of up to 0.9 inches, within the floor slab are possible with changing moisture conditions of the underlying clay soil. In order to reduce the PVR of the clay soil to about 0.6 inches, it is recommended that the native soil be over excavated 24 inches. The excavated surface should then be scarified 8 inches, brought to within plus or minus 3 percent of optimum moisture content and compacted. A modulus of subgrade reaction value of 250 pci is recommended for slabs cast directly on prepared subgrade.

A structural, suspended slab is recommended if the anticipated differential movements cannot be tolerated by the floating slab.

Where granular base is used, it should meet the following grading requirements as determined in accordance with ASTM D 422:

Sieve Size (Square Openings)	Percent Passing by Dry Weight
1 inch	100
¾ inch	85-100
no. 4	45-95
no. 200	0-8

The granular base should have a plasticity index of no greater than 12 when tested in accordance with ASTM D 4318. The coarse aggregate should have a percent of wear, when subjected to the

Los Angeles abrasion test (ASTM C 131), of no greater than 50. Granular base should be compacted to at least 95 percent of maximum dry density in accordance with ASTM D 1557.

Granular base will tend to act as a capillary barrier to moisture, but will not provide a positive barrier against the rise of moisture to the slab. If the moisture sensitivity of floor coverings is considered critical, an impervious membrane vapor barrier should be placed beneath the floor slab.

5.5 SITE DRAINAGE AND MOISTURE PROTECTION

Substantial moisture increases in the soil supporting foundations and slabs would reduce their support value and increase foundation movements. Therefore, positive site drainage should be provided during construction and maintained thereafter.

Where slabs or pavements do not immediately adjoin the proposed structure, the ground surface should be sloped away from the perimeter of the building in a manner to allow flow along the drainage lines at a minimum grade of 5 percent to points at least 15 feet away. Positive drainage should be provided from these points to streets or natural water courses. In no case should long-term ponding of water be allowed around the perimeter of the structure.

Landscaped areas should not be allowed immediately adjacent to the planned structure unless contained in water tight boxes or constructed with a controlled outlet. All landscaping near the structure should consist of short rooted, desert type plants requiring little or no watering. Irrigation drip systems near the structure, particularly in areas underlain by impervious membrane, should be avoided.

The possibility of moisture infiltration beneath the proposed structure, in the event of plumbing leaks, should be considered in the design and inspection of underground water and sewer conduits. All backfill behind footings and stem walls as well as utility trench backfill within 15 feet of the structure should be compacted as recommended for structural fill in Appendix C.

5.6 LATERAL LOADS

The pressure exerted on retaining walls will depend on their degree of restraint. Rigid, restrained walls with horizontal backfill meeting structural fill requirements as presented in Appendix C of the geotechnical report, should be designed using an "at rest" equivalent fluid pressure of 55 pounds per cubic foot (pcf). Walls allowed to rotate around their bases at a distance of 0.001 times their height or more, at the top, should be designed using an "active" equivalent fluid pressure of 35 pcf. Passive pressures for properly compacted structural fill against footings and stem walls should be computed using an equivalent fluid pressure of 340 pcf. A coefficient of friction (f) of 0.40 may be used in calculations for sliding purposes between the base of the footing and soil.

The equivalent fluid pressures do not include any lateral component due to either hydrostatic or surcharge loads. The retaining walls at this site should be designed with a drainage system to prevent the build up of hydrostatic forces behind the wall. If a drain system is not provided, then an additional 62.4 pcf must be added to the lateral forces acting on the wall. Special care should be taken not to over compact the backfill material to reduce the potential for the build up of residual compaction pressures against the retaining walls.

The equivalent fluid pressures provided above do not include a factor of safety, however, we recommend that a minimum factor of safety of 1.5 be used for the design of retaining walls against overturning and sliding. Surcharge loads, such as vehicular wheel loads, to the area adjacent to the retaining wall can add additional horizontal components of lateral earth pressures to this wall. The magnitude of these components will depend on the loads and locations of these loads relative to the retaining wall.

5.7 CONSTRUCTION OBSERVATION AND TESTING

Recommendations presented in previous sections of this report are predicated on the fact that there will be continuous observation and testing by the geotechnical engineer during earthwork operations. Verification of recommended moisture increases, site grading and required degree of compaction should be performed in accordance with "Guide Specifications for Earthwork," Appendix C.

The recommendations presented in this report are based upon a limited number of subsurface samples obtained from three sampling locations. The samples may not fully indicate the nature and extent of the variations that actually exist throughout the site. For that reason, among others, AEE strongly recommends that AEE be retained to observe earthwork construction. It should be noted, if variations or other latent conditions become evident during earthwork construction, it will be necessary for AEE to review these conditions and modify its recommendations.

TEST DRILLING EQUIPMENT & PROCEDURES

SAMPLING PROCEDURES - Dynamically driven tube samples are usually obtained at selected intervals in the borings by the ASTM D-1586 procedures. In most cases, 2" O.D., 1 ⅜" I.D. samplers are used to obtain the standard penetration resistance. "Undisturbed" samples of firmer soil are often obtained with 3" O.D. samplers lined with 2.42" I.D. brass rings. The driving energy is generally recorded as the number of blows of a 140 pound, 30-inch free fall drop hammer required to advance the samplers in 6-inch increments. However, in stratified soil, driving resistance is sometimes recorded in 2 or 3-inch increments so that soil changes and the presence of scattered gravel or cemented layers can be readily detected and the realistic penetration values obtained for consideration in design. These values are expressed in blows per foot on the logs. "Undisturbed" sampling of softer soil is sometimes performed with thin walled Shelby tubes (ASTM D-1587). Where samples of rock are required, they are obtained by NX diamond core drilling (ASTM D-2113). Tube samples are labeled and placed in watertight containers to maintain field moisture contents for testing. When necessary for testing, larger bulk samples are taken from auger cuttings.

CONTINUOUS PENETRATION TESTS - Continuous penetration tests are performed by driving a 2" O.D. blunt nosed penetrometer adjacent to or in the bottom of borings. The penetrometer is attached to 1 ⅝" O.D. drill rods to provide clearance to minimize side friction so that penetration values are as nearly as possible a measure of end resistance. Penetration values are recorded as the number of blows of a 140 pound, 30-inch free fall drop hammer required to advance the penetrometer in one foot increments or less.

BORING RECORDS - Drilling operations are directed by our field engineer or geologist who examines soil recovery and prepares boring logs. Soil is visually classified in accordance with the Unified Soil Classification System (ASTM D-2487), with appropriate group symbols being shown on the logs.

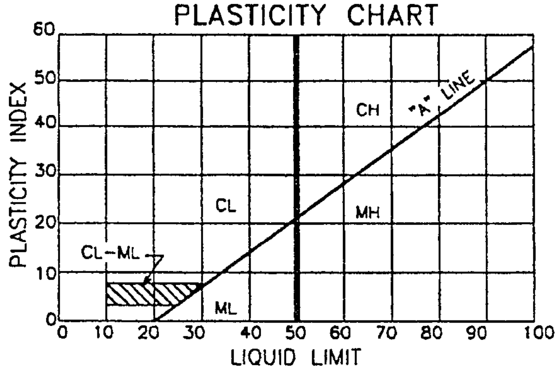
UNIFIED SOIL CLASSIFICATION SYSTEM

Soils are visually classified by the Unified Soil Classification System on the boring logs presented in this report. Grain-size analysis and Atterberg Limits Tests are often performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. For a more detailed description of the system, see "The Unified Soil Classification System", Corp of Engineers, US Army Technical Memorandum No. 3-357 (Revised April 1960) or ASTM Designation: D2487-93T.

MAJOR DIVISIONS				GRAPHIC SYMBOL	GROUP SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (50% or less of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 sieve)			GW	Well graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
					GP	Poorly graded gravels, gravel-sand mixtures or sand-gravel-cobble mixtures
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line or hatched zone on plasticity chart		GM	Silty gravels, gravel-sand-silt mixtures
			Limits plot above "A" line & hatched zone on plasticity chart		GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS (More than 50% of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 seive)			SW	Well graded sands, gravelly sands
					SP	Poorly graded sands, gravelly sands
		SANDS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line or hatched zone on plasticity chart		SM	Silty sands, sand-silt mixtures
			Limits plot above "A" line & hatched zone on plasticity chart		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more passes No. 200 sieve)	SILTS Limits plot below "A" line or hatched zone on plasticity chart	SILTS OF LOW PLASTICITY (Liquid Limit Less Than 50%)			ML	Inorganic silts, clayey silts with slight plasticity
		SILTS OF HIGH PLASTICITY (Liquid Limit More Than 50%)			MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts
	CLAYS Limits plot above "A" line & hatched zone on plasticity chart	CLAYS OF LOW PLASTICITY (Liquid Limit Less Than 50%)			CL	Inorganic clays of low to medium plasticity; gravelly clays, sandy clays, silty clays, lean clays
		CLAYS OF HIGH PLASTICITY (Liquid Limit More Than 50%)			CH	Inorganic clays of high plasticity, fat clays, sandy clays of high plasticity

NOTE: Coarse grained soils with between 5% & 12% passing the No. 200 sieve and fine grained soils with limits plotting in the hatched zone on the plasticity chart to have double symbol.

PLASTICITY CHART



DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
COBBLES	Above 3 inches
GRAVEL	3 inches to No. 4 sieve
Coarse Gravel	3 inches to 3/4 inch
Fine Gravel	3/4 inch to No. 4 sieve
SAND	No. 4 sieve to No. 200
Coarse	No. 4 sieve to No. 10
Medium	No. 10 sieve to No. 40
Fine	No 40 sieve to No. 200
FINES (SILT or CLAY)	Below No. 200 sieve

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TERMINOLOGY USED TO DESCRIBE THE RELATIVE DENSITY CONSISTENCY, OR FIRMNESS OF SOIL

The terminology used on the boring logs to describe the relative density, consistency or firmness of soil relative to the standard penetration resistance is presented below. The standard penetration resistance (N) in blow per foot is obtained by ASTM D-1586 procedure using 2" O.D., 1⅜" I.D. samplers.

RELATIVE DENSITY: Terms for description of relative density of cohesionless, uncemented sand and sand-gravel mixtures.

N	RELATIVE DENSITY
0-4	Very Loose
5-10	Loose
11-30	Medium Dense
31-50	Dense
50+	Very Dense

RELATIVE CONSISTENCY: Terms for the description of clay which is saturated or near saturation.

N	RELATIVE CONSISTENCY	REMARKS
0-2	Very Soft	Easily penetrated several inches with fist.
3-4	Soft	Easily penetrated several inches with thumb.
5-8	Medium Stiff	Can be penetrated several inches with thumb moderate effort.
9-15	Stiff	Readily indented with thumb but penetrated only with great effort.
16-30	Very Stiff	Readily indented with thumbnail.
30+	Hard	Indented only with difficulty by thumbnail.

RELATIVE FIRMNESS: Terms for the descriptions of partially saturated and/or cemented soil which commonly occurs in the Southwest including clay, cemented granular materials, silt and silty and clayey granular soil:

N	RELATIVE DENSITY
0-4	Very Soft
5-8	Soft
9-15	Moderately Firm
16-30	Firm
31-50	Very Firm
50+	Hard

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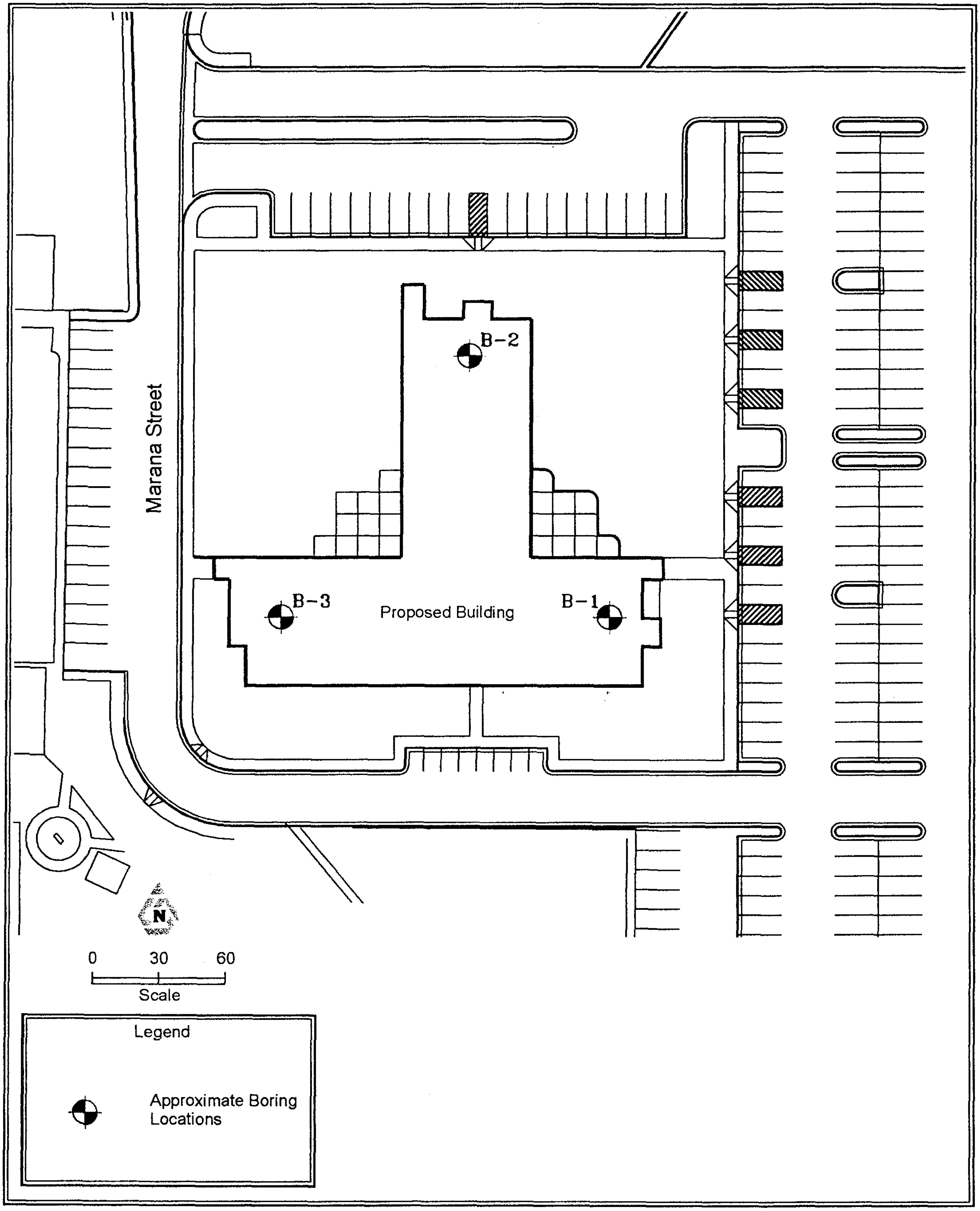
SOIL MOISTURE CLASSIFICATION

MOISTURE CONDITION	FIELD IDENTIFICATION	ESTIMATED RANGE OF MOISTURE	
		Group A (%)	Group B (%)
Dry	Absence of moisture, dusty. Dry to the touch.	0-4	0-8
Damp	Grains appear slightly darkened, but no visible water. Silt/clay may clump. Sand will not bulk. Soils are below plastic limits.	4-8	8-16
Moist	Grains appear darkened, but no visible water. Silt/clay will clump. Sand will bulk. Soils are often at or near plastic limits.	8-16	16-30
Wet	Visible water on larger grain surfaces. Sand and cohesionless silt exhibit dilatancy. Cohesive silt/clay can be readily remolded. "Wet" indicates that the soil is much wetter than the optimum moisture content and above the plastic limit (APL).	>16	>30
Water Bearing	A water-producing formation.	N/A	N/A

Group A - <u>Coarse Grained Soils,</u> nonplastic to plasticity index <7.
Includes: SM, SP-SM, SP, SW, GM, GP, and GW.

Group B - <u>Fine Grained Soils</u> to clayey sands & gravels with a plasticity index >7.
Includes: GC, SC, ML, MH, CL, and CH.



Geotechnical Study
Proposed Office Building-FLETC
Artesia, New Mexico
AEE Job No. 0-717-000246

Figure 1

Site Plan
July 2000

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PROJECT Proposed Office Building-FLETC

JOB NO. 0-717-000246 DATE 7/8/2000

LOG OF TEST BORING NO. B-1

SHEET 1 OF 2

RIG TYPE CME-75

BORING TYPE 8 1/4" Hollow Stem Auger

SURFACE ELEV. -

DATUM -

Depth in feet	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content % of Dry Weight	Unified Soil Classification	Atterberg Limits PL	LL	PI	REMARKS	VISUAL CLASSIFICATION
0		X	S	7			CL				SOFT TO FIRM	SILTY SANDY CLAY, low to medium plasticity, light brown, moist
5		X	S	25		23.0		19	47	28		note: slight to moderate lime cementation beginning at 9'.
10		X	S	27		12.1						
15		X	S	29								
							CL				MODERATELY FIRM TO HARD	SILTY CLAY, fine, some gravel, low plasticity, brown, dry
20		X	S	56								
25		X	S	14		23.3						note: gravel and cobble layer at 30' and 35'.
30		X	S	50(5")								
35		X	S	40								
40												

GROUND WATER

DEPTH	HOUR	DATE
-	-	-
-	-	-

SAMPLE TYPE

A - Auger cuttings B - Block sample
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 3" O.D. thin-walled Shelby tube

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PROJECT Proposed Office Building-FLETC

JOB NO. 0-717-000246 DATE 7/8/2000

LOG OF TEST BORING NO. B-1

SHEET 2 OF 2

Depth in feet	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content % of Dry Weight	Unified Soil Classification	Atterberg Limits PL	LL	PI	REMARKS	VISUAL CLASSIFICATION
40			S	20		20.9	CL	23	48	25		CLAY, some sand, occassional gravel, medium plasticity, brown, moist
											FIRM	
45			S	23								
50			S	13			CL					CLAY, some silt, low to medium plasticity, brown, damp
											MODERATELY FIRM TO FIRM	
55			S	19								
60			S	24								
												AUGER STOPPED @ 60' SAMPLER STOPPED @ 61'6"
65												
70												
75												
80												

GROUND WATER

DEPTH	HOUR	DATE
-	-	-
-	-	-

SAMPLE TYPE

A - Auger cuttings B - Block sample
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 3" O.D. thin-walled Shelby tube

AGRA
ENGINEERING GLOBAL SOLUTIONS

PROJECT Proposed Office Building-FLETC

JOB NO. 0-717-000246 DATE 7/8/2000

LOG OF TEST BORING NO. B-2

SHEET 1 OF 2

RIG TYPE CME-75

BORING TYPE 8 1/4" Hollow Stem Auger

SURFACE ELEV. -

DATUM -

Depth in feet	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content % of Dry Weight	Unified Soil Classification	Atterberg Limits PL	LL	PI	REMARKS	VISUAL CLASSIFICATION
0		X	S	7			CL				SOFT TO FIRM	SILTY CLAY, slight lime cementation, low plasticity, light brown, dry
5		X	S	26		4.0		14	27	13		
10		X	S	19			CL				MODERATELY FIRM TO VERY FIRM	SILTY CLAY, medium plasticity, slight to moderate lime cementation, scattered gravel, light brown, damp
15		X	S	19		16.1						
20		X	S	44								
25		X	S	9		19.5						
30		X	S	21								
35		X	S	36		21.7		13	39	26		
40												

GROUND WATER

DEPTH	HOUR	DATE
-	-	-
-	-	-

SAMPLE TYPE

A - Auger cuttings B - Block sample
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 3" O.D. thin-walled Shelby tube

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ENGINEERING GLOBAL SOLUTIONS

PROJECT Proposed Office Building-FLETC

JOB NO. 0-717-000246 DATE 7/8/2000

LOG OF TEST BORING NO. B-2

SHEET 2 OF 2

Depth in feet	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content % of Dry Weight	Unified Soil Classification	Atterberg Limits PL	LL	PI	REMARKS	VISUAL CLASSIFICATION
40			S	50			CL				MODERATELY FIRM TO VERY FIRM	CLAY, some silt, medium plasticity, light brown, damp
45			S	15								
50			S	13			CL				MODERATELY FIRM TO FIRM	CLAY, some silt, occassional gravel, medium plasticity, brown, damp
55			S	15								
60			S	19								
												AUGER STOPPED @ 60' SAMPLER STOPPED @ 61'6"
65												
70												
75												
80												

GROUND WATER

DEPTH	HOUR	DATE
-	-	-
-	-	-

SAMPLE TYPE

A - Auger cuttings B - Block sample
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 3" O.D. thin-walled Shelby tube

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PROJECT Proposed Office Building-FLETC
JOB NO. 0-717-000246 DATE 7/8/2000

LOG OF TEST BORING NO. B-3

SHEET 1 OF 2
RIG TYPE CME-75
BORING TYPE 8 1/4" Hollow Stem Auger
SURFACE ELEV. -
DATUM -

Depth in feet	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content % of Dry Weight	Unified Soil Classification	Atterberg Limits PL	LL	PI	REMARKS	VISUAL CLASSIFICATION
0			S	15			CL					SILTY CLAY, moderate lime cementation induration, low plasticity, light brown, damp
5			S	20		13.0					MODERATELY FIRM TO FIRM	
10			S	20		15.4		18	49	31		
							CL					SILTY CLAY, some gravel, slight to moderate lime cementation, low to medium plasticity, light brown, damp
15			S	18								
20			S	21		16.6					FIRM	
25			S	20								
30			S	29		16.0	CL	12	20	8		SILTY CLAY, moderate lime cementation, medium plasticity, brown to light brown, damp
35			S	18							FIRM	
40												

GROUND WATER

DEPTH	HOUR	DATE
-	-	-
-	-	-

SAMPLE TYPE

A - Auger cuttings B - Block sample
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 3" O.D. thin-walled Shelby tube

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ENGINEERING GLOBAL SOLUTIONS

PROJECT Proposed Office Building-FLETC

JOB NO. 0-717-000246 DATE 7/8/2000

LOG OF TEST BORING NO. B-3

SHEET 2 OF 2

Depth in feet	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content % of Dry Weight	Unified Soil Classification	Atterberg Limits PL	LL	PI	REMARKS	VISUAL CLASSIFICATION
40		X	S	15			CL				MODERATELY FIRM TO FIRM	SILTY CLAY, medium plasticity, light brown, damp
45		X	S	16		17.7						
50		X	S	14								
55		X	S	19								
60		X	S	21								AUGER STOPPED @ 60' SAMPLER STOPPED @ 61'6"
65												
70												
75												
80												

GROUND WATER

DEPTH	HOUR	DATE
-	-	-
-	-	-

SAMPLE TYPE

A - Auger cuttings B - Block sample
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TABULATION OF TEST RESULTS

DATE: JULY 11, 2000

PROJECT: GEOTECHNICAL STUDY
PROPOSED OFFICE BUILDING
EL PASO, TEXAS

AEE JOB NO.: 0-717-000246

LAB NO.: 1980

BORING NO.	LOCATION	DEPTH	UNIFIED CLASS.	LL	PI	SIEVE ANALYSIS - ACCUM. % PASSING												MOISTURE %	LAB NO.
						200	80	40	10	4	3/8	1/2	3/4	1	1-1/2	3	6		
B1	SEE SITE PLAN	5	CL	47	28	78.4	81	99	100									23.0	1980-1
B1	SEE SITE PLAN	40	CL	48	25	74.2	82	86	88	89	92	100						20.9	1980-2
B2	SEE SITE PLAN	5	CL	27	13	68.6	88	96	98	100								4.0	1980-3
B2	SEE SITE PLAN	35	CL	39	26	73.9	94	97	99	100								21.7	1980-4
B3	SEE SITE PLAN	10	CL	49	31	83.2	92	96	100									15.4	1980-5
B3	SEE SITE PLAN	30	CL	20	8	73.2	83	87	90	92	93	100						16.0	1980-6

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GUIDE SPECIFICATIONS FOR EARTHWORK

1. SCOPE

Includes all clearing and grubbing, removal of obstructions, general excavating, grading and filling and any related items necessary to complete the grading for the entire project in accordance with these specifications.

2. SUBSURFACE SOIL DATA

Subsurface soil studies have been made, and the results are available for examination by the contractor. The contractor is expected to examine the site and determine for himself the character of materials to be encountered.

No additional allowance will be made for rock removal, site clearing and grading, filling, compaction, disposal or removal of any unclassified materials.

3. CLEARING AND GRUBBING

A. **General:** Clearing and grubbing will be required for all areas shown on the plans to be excavated or on which fill is to be constructed.

B. **Clearing:** Clearing shall consist of removal and disposal of vegetation as well as down brush and rubbish within the areas to be cleared.

C. **Grubbing:** Stumps, matted roots and roots larger than 2 inches in diameter shall be removed from within 6 inches of the surface of areas on which fills are to be constructed except in paved areas. Materials as described above within 18 inches of finished subgrade of paved areas in either cut or fill sections shall be removed. Areas disturbed by grubbing will be filled as specified hereinafter for STRUCTURAL FILL.

D. **Grass & Topsoil:** Grass, grass roots and incidental topsoil shall not be left beneath a fill area, nor shall this material be used as fill material. Grass, grass roots and topsoil may be stockpiled and later used in the top 6 inches of fills outside paved areas and building pads.

4. EARTH EXCAVATION

A. Earth excavation shall consist of the excavation and removal of suitable soil for use as embankment as well as the satisfactory disposal of all vegetation, debris and deleterious materials encountered within the area to be graded and/or in a borrow area.

B. Excavated areas shall be continuously maintained such that the surface shall be smooth and have sufficient slope to allow water to drain from the surface.

5. STRUCTURAL FILL

A. **General:** Structural fill shall consist of a controlled fill constructed in areas indicated on the grading plans.

B. **Materials:**

(1) Physical Characteristics: Structural fill material shall consist of soil that conforms to the following physical characteristics:

Sieve Size (Square Openings)	Percent Passing by Weight
3 inch	100
3/4 inch	70 - 100
no. 4	40 - 100
no. 200	15 - 35

The plasticity index of the material, as determined in accordance with ASTM D 4318, shall not exceed 12. The fill material shall be free from roots, grass, other vegetable matter, clay lumps, rocks larger than 3 inches in any dimension, or other deleterious materials.

(2) Site Soil: Site soil from cuts may be used for fill, provided they meet the requirements in paragraph 5.B.(1). The results of this study indicate most of the soil at the site **will not** meet these requirements.

(3) Borrow: When the quantity of suitable material required for embankments is not available within the limits of the jobsite, the contractor shall provide sufficient materials to construct the embankments to the lines, elevations and cross sections as shown on the drawings from borrow areas. The contractor shall obtain from owners of said borrow areas the right to excavate material, shall pay all royalties and other charges involved, and shall pay all expenses in developing the source including the cost of right-of-way required for hauling the material.

C. **Construction:**

(1) Deep Foundation System: The building pad should be inspected by a representative of the geotechnical engineer prior to fill placement to verify clearing and grubbing.

Continuous observation of the construction of pier foundations shall be conducted by a representative of the geotechnical engineer (RGE). The RGE shall verify the proper diameter of the shaft, depth, cleaning and also confirm the nature of materials encountered in the pier excavations.

(2) Slabs-on-grade: Below slabs-on-grade, the native soil shall be over excavated 24 inches. The excavated surface shall then be scarified 8 inches, watered as necessary to bring the scarified soil to within plus or minus 3 percent of optimum moisture content and compacted. Structural fill shall then be added, as required, in compacted lifts to final grade.

(3) Compaction: The structural fill shall be placed in no greater than 6 inch compacted lifts. Moisture content at the time of compaction shall be within 3 percent of optimum moisture content. Compaction of the fill in building areas, paved areas, below sidewalks and slabs shall be accomplished by mechanical means only to obtain a density of not less than 95 percent of maximum dry density for the building pad. Embankments outside the building pad and other structural areas shall be compacted to 90 percent of maximum dry density. Optimum moisture content and maximum dry density for each soil type used shall be determined in accordance with ASTM D 1557. Where vibratory compaction equipment is used, it shall be the contractor's responsibility to insure that the vibrations do not damage nearby buildings or other adjacent property.

(4) Weather Limitations: Controlled fill shall not be constructed when the atmospheric temperature is below 35 degrees F. When the temperature falls below 35 degrees, it shall be the responsibility of the contractor to protect all areas of completed surface against any detrimental effects of ground freezing by methods approved by the geotechnical engineer. Any areas that are damaged by freezing shall be reconditioned, reshaped and compacted by the contractor in conformance with the requirements of this specification without additional cost to the owner.

D. **Slope Protection & Drainage:** The edges of the controlled fill embankments shall be graded to the contours shown on the drawings and compacted to the density required in paragraph 5.C.(3). Slopes steeper than 1 vertical to 3 horizontal shall be protected from erosion.

6. INSPECTION & TESTS

A. **Field Inspection & Testing:** The owner shall employ the services of a registered, licensed geotechnical engineer for consultation during all controlled earthwork operations. The geotechnical engineer shall provide continuous observation and testing by experienced personnel during construction of controlled earthwork. The contractor shall notify the engineer at least two working days in advance of any field operations of the controlled earthwork, or of any resumption of operations after stoppages. Tests of fill materials and embankments will be made at the following suggested minimum rates:

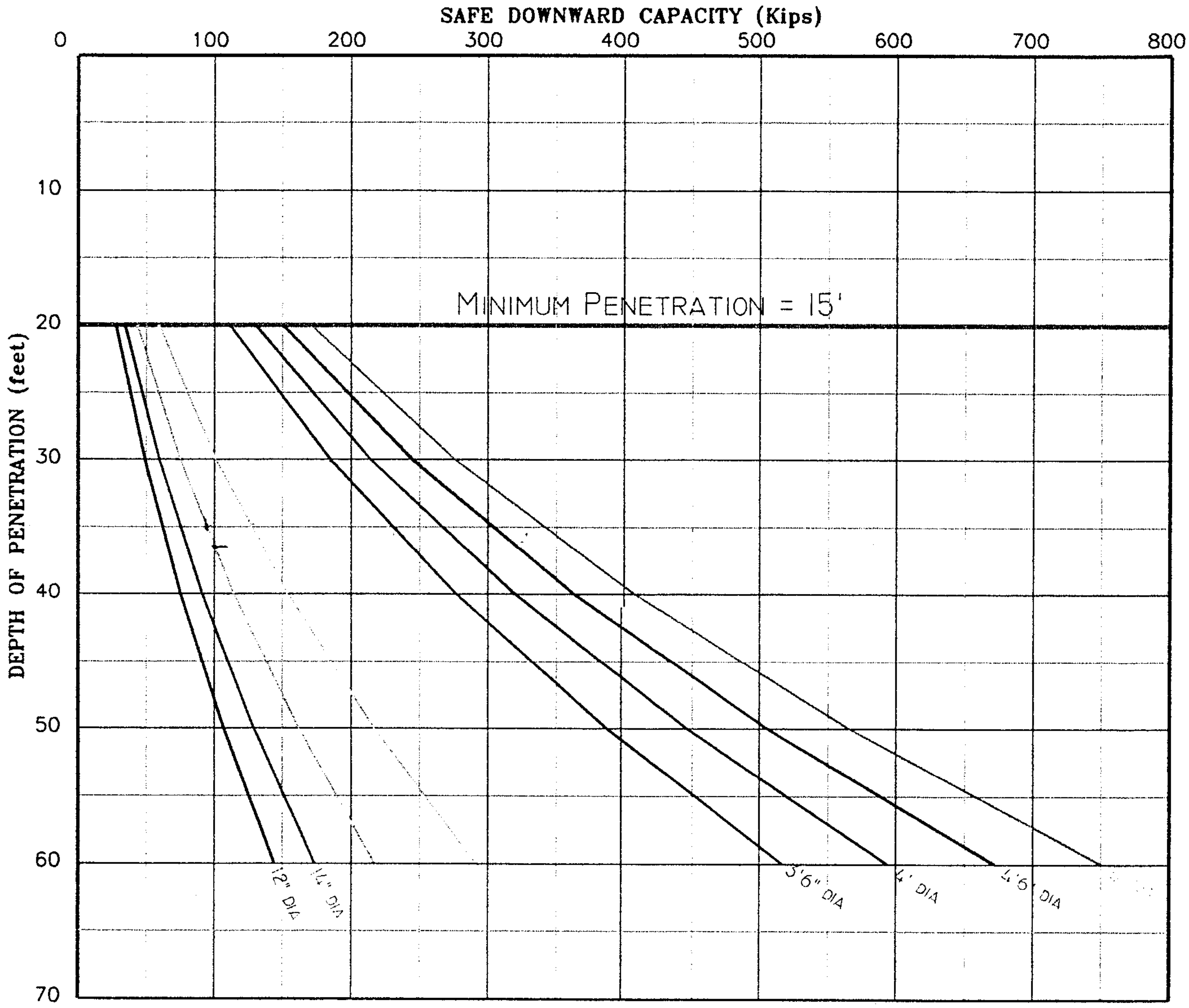
(1) One field density test for each 2,500 square feet of original ground surface prior to placing fill or floor slab construction.

(2) One field density test for each 2,500 square feet of fill placed or each layer of fill for each work area, whichever is the greater number of tests.

(3) One moisture-density curve for each type of material used, as indicated by sieve analysis and plasticity index.

B. **Report of Field Density Tests:** The geotechnical engineer shall submit, daily, the results of field density tests required by these specifications.

C. **Costs of Tests & Inspection:** The costs of tests, inspection and engineering, as specified in this section of the specifications, shall be borne by the owner.



Geotechnical Study Proposed Office Building El Paso, Texas AEE Job No. 0-717-000246	Figure 2	Capacity Chart AGRA ENGINEERING GLOBAL SOLUTIONS